

MONTHLY WEATHER REVIEW,

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(General Weather Service of the United States.)

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to April 14th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 139 Signal Service stations and 14 Canadian stations, as telegraphed to this office; 140 monthly journals and 158 monthly means from the former, and 12 monthly means from the latter; reports from 27 Sunset stations; 234 monthly registers from Voluntary Observers; 46 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers in, and the local Weather Service of, Missouri; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

Barometric Pressure.—The pressure for the month is remarkable for its equitable distribution from the Mississippi valley eastward to the Atlantic Ocean. As compared with the March averages of the preceding eight years the distribution is decidedly abnormal. From the Missouri valley eastward to the Atlantic an excess of pressure prevailed, averaging 0.05 above the normal and reaching 0.08 above over Lake Ontario. There was a slight deficiency in the pressure of the South Atlantic and Eastern Gulf States. An excess of 0.03 above prevailed at San Diego and San Francisco and of 0.06 above at Portland, Or. The mean at Virginia City was 0.03 below.

Local Barometric Ranges.—The barometric ranges in the Atlantic States regularly increased to the northward, from 0.34 at Key West to 1.09 at Norfolk, 1.18 at New York city and 1.48 at Thatcher's Island, with an extreme range of 1.57 at Burlington, Vt. The range on Mt. Washington, however, was but 0.96, being 0.50 below the average of the surrounding New England stations. A similar increase northward occurs from an average of 0.55 along the Gulf coast to an average of 1.30 in the Ohio valley and Missouri. Unusual ranges occurred in the Lake region and Upper Mississippi valley. The average range for the Lower Lake region is 1.40, the Upper Lake region 1.50 and the Upper Mississippi valley 1.60. Extreme ranges of 1.70 occurred at Milwaukee, Dubuque and La Crosse, of 1.73 at Madison, Wis. and 1.84 at Fort Buford. On the Pacific coast the range regularly increased to the northward from 0.44 at Los Angeles to 1.28 at Olympia and 1.39 at Umatilla. The pressure over the Plateaux and Rocky Mountain districts ranged from 0.45 in the southern part to 0.92 in the northern.

Areas of High Pressure.—During the month twelve areas of high pressure have appeared within the limits of the Signal Service maps. The most notable area is No. II, which remained stationary and without decided change of pressure in the North Pacific coast region from the 5th to the 15th.

No. I.—This area, central in the Ohio valley the morning of the 1st, moved slowly eastward and was central during the 2nd on the Middle Atlantic coast, and by the morning of the 3rd had withdrawn eastward over the Atlantic ocean. The highest pressure during its passage was reported from Cape Henry at midnight, the barometer being 0.48 above the normal. Cautionary Signals were displayed on the morning of the 2nd at Ft. Macon, Cape Lookout and Cape Hatteras. These signals were justified but remained displayed until the morning of the 4th in connection with low area No. I.

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No. II.—This area appeared on the Pacific coast during the 5th, the p. m. barometer at Red Bluff being 0.25 above the normal. During the 6th it moved slightly northward to the North Pacific coast region, where it remained until the afternoon of the 15th, the highest pressure being regularly reported at Olympia, rising at that station from 0.40 above the normal during the 6th to 0.67 above on the 8th, and 0.66 on the 12th. This area gradually dissipated in advance of low area No. XI. During the increase of pressure from the 6th to the 8th, rain fell in the North Pacific coast region. During the 8th while this pressure was increasing in Washington Territory the barometer fell sharply in the southern half of the Pacific coast region in connection with low area No. VII, which, moving southwestward from Wyoming, was central at midnight in southern California. Exceedingly high winds were reported in northern and central California, and maximum velocities of N. 44 miles at San Francisco and N. 36 miles at Sacramento were reported. In San Francisco Bay two schooners and one barge were sunk and eight other vessels more or less damaged. At Willows, Cal., a terrific gale prevailed during the forenoon, moving a church from its foundations and seriously damaging it. At Colusa several buildings were blown down and others seriously damaged; at Maxwell a warehouse was blown down; in Napa valley many buildings were blown down and large trees uprooted; at Dayton a barn blown down; at Livermore considerable damage was done; at San Leandro and in El Dorado county many trees were blown down. The minimum temperatures for the Pacific coast generally occurred during the continuance of this area.

No. III.—This area appeared on the afternoon of the 5th in the Missouri valley. It moved northeastward through the Ohio valley to New England and Nova Scotia, thence withdrawing northeastward over the Atlantic ocean by midnight of the 7th. The maximum pressure was reported from Halifax on the 7th, the barometer being 0.47 above the normal. In connection with this area Cautionary Signals were displayed on the morning of the 6th at Grand Haven, Milwaukee and Ludington, and were lowered on the 7th, having been justified; maximum velocity 26 miles NW. at Milwaukee. At midnight of the 6th Cautionary Signals were displayed on the Atlantic coast from Sandy Hook southward to Ft. Macon, which remaining displayed during the passage of low area No. IV are treated of in connection therewith.

No. IV.—This area appeared in the Northwest at midnight of the 6th; its pressure increased until the morning of the 7th, Fort Garry barometer 30.81 or 0.64 above the normal. On the morning of the 7th the Cautionary Signal at Indianola was changed to Cautionary Off-shore and in the afternoon a similar signal was ordered at Galveston. These signals were lowered during the afternoon of the 8th, having been justified by wind velocities of N. 28 and N. 36 miles. Moving eastward, on the morning of the 8th it was central in the province of Quebec—Rockliffe barometer 0.62 above the normal—and during the 9th it gradually withdrew eastward over the Atlantic ocean. The passage of this area was marked by the minimum temperatures for the month at most stations in the Lower Lake region, New England and New York, the lowest readings being 1° below zero at Burlington on the 8th and Eastport on the 9th. In connection with this area signals displayed for advancing low area No. III were changed at midnight of the 7th on the New Jersey coast from Cautionary to Off-shore, and were fully justified by velocities ranging from 26 to 36 miles from the North and Northwest. Cautionary Off-shore Signals were ordered the morning of the 8th at Boston and Portland, and the Cautionary Signals at Newport and Wood's Holl were changed to Cautionary Off-shore. These signals were lowered that evening, justified by wind velocities of NW. 36 at Thatcher's Island and NW. 28 at Boston.

No. V.—This pressure appeared in the Northwest the morning of the 9th, Fort Garry barometer 0.41 above the normal. Moving eastward through Canada it reached New Brunswick by midnight of the 11th, Chatham barometer 0.52 above the normal. During its passage, minimum temperatures for the month occurred at scattering stations in the Upper Lake region, the lowest readings reported being 6° below zero at Marquette and 8° below zero at Alpena on the 10th. Off-shore Signals were displayed at Sandy Hook at noon, from New London northward along the coast to Thatcher's Island in the afternoon, and at Eastport at midnight of the 10th. The signal at Eastport was lowered during the afternoon of the 11th, and at other stations changed during that day to Cautionary in connection with advancing low area No. VIII. The signals at New England stations were justified by velocities ranging from N. 26 at Eastport to W. 35 at Wood's Holl.

No. VI.—This area appeared in the Northwest on the 11th, and at midnight the pressure at Fort Garry was 30.91 or 0.80 above the normal and the temperature 18° below zero. Moving eastward at midnight of the 12th, the highest pressure was at Rockliffe, 30.68, or 0.74 above the normal. During the 13th the pressure withdrew eastward over the Bay of St. Lawrence. In connection with advancing low area No. VII Cautionary Signals were displayed during the 12th from Norfolk along the coast northward to Thatcher's Island, and were lowered on the morning of the 14th, having been generally justified by velocities ranging from 26 NE. at New York to 44 NE. at Delaware Breakwater, along the New Jersey coast, and N. 34 at Thatcher's Island.

No. VII.—This area appears to have been a part of the last area. On the 13th, moving southward from Manitoba, the highest pressure at midnight was central in the Missouri valley—Omaha barometer 0.45 above the normal. The area extending from the Lower Missouri valley southward to Texas remained substantially unchanged until the 17th, when, moving eastward, the highest pressure in the afternoon was at Cincinnati, the barometer being 0.33 above the normal. It withdrew slowly eastward from the New England coast over the Atlantic ocean during the 18th. During the passage of this area minimum temperatures of the

month occurred as follows: in the Upper Mississippi and Lower Missouri valleys on the 14th, (lowest reading 7° below zero at St. Paul and Omaha;) in Tennessee and part of the Ohio valley, the 16th and 17th, (lowest reading at Indianapolis, 21°;) in the Western Gulf States from the 14th to the 17th, (lowest reading 23° at Corsicana on the 14th.) At midnight on the 13th, the wind continuing brisk at Indianola, Off-shore Signals, which had been lowered that morning, were again displayed at Galveston, Indianola and Port Eads, and were continued to midnight of the 14th, when they were lowered, having been justified by velocities of 43 miles N. at Indianola, 31 miles at Galveston, and — at Port Eads. On the afternoon of the 16th Cautionary Signals displayed in advance of low area No. X were changed on the New Jersey coast to Cautionary Off-shore Signals, and the Cautionary Signals from Cape Lookout to Cape Henry were continued. Cautionary Signals were displayed at Smithville and Wilmington on the morning of the 17th. The New Jersey coast signals were lowered the afternoon of the 17th, fully justified by velocities ranging from 25 NW. at Barnegat to 42 NW. at Cape May. Those on the North Carolina coast were lowered at midnight of the 17th, fully justified by velocities ranging from 32 NE. at Fort Macon to 48 NE. at Kittyhawk.

No. VIII.—This area appeared on the North Pacific coast during the 18th, the pressure at Olympia, from the 19th to midnight of the 21st, ranged from 0.48 to 0.59 above the normal. The area gradually dissipated during the 22nd. While the pressure was increasing during the 18th and 19th occasional light rain fell in Oregon; otherwise clear weather generally prevailed on the Pacific coast.

No. IX.—This area followed low area No. XI, central in the Northwest at midnight of the 19th, moved slowly southward to Texas, where it dissipated on the 22nd. The highest pressure occurred at Dodge City on the afternoon of the 20th, 0.35 above the normal. Cautionary Signals were displayed at New Orleans and Port Eads at midnight of the 21st, and were lowered at midnight of the 22nd. Reports, as yet received, do not show that they were justified. From the 20th to the 22nd easterly winds with maximum velocities, ranging from 27 to 38 miles, were reported from the Texas coast.

No. X.—The pressure in the Northwest rose very rapidly on the 23rd in rear of low area No. XIV. At the afternoon report the pressure at Breckenridge was 0.40 above the normal. Moving eastward with increasing pressure on the morning of the 24th it was central in the Upper Lake region, Marquette barometer 0.63 above the normal. Moving slowly eastward, it passed off the Middle Atlantic coast during the 25th. During its passage the minimum temperatures of the month occurred in the Middle Atlantic States, the southern half of New England and in Ohio. During the 23rd the Cautionary Signals ordered for low area No. XIV were changed to Off-shore from Norfolk northward to Portland, and on the following morning at Eastport. These signals were lowered during the 24th having been fully justified by velocities ranging from 30 NW. at Portland to 54 NW. at Wood's Holl on the New England coast, and from 36 NW. at New York to 56 NW. at Sandy Hook and Cape Henry and 44 N. at Kittyhawk along the Middle Atlantic coast.

No. XI.—This area appeared in the Northwest on the 28th and moving eastward continued on the Upper Lake region during the 29th and 30th. During the 31st it gradually disappeared. The highest pressure was reported from Marquette the morning of the 30th—0.42 above the normal. During the 29th occasional high winds were reported from Lakes Erie and Huron. No signals were displayed during the passage of this area.

No. XII.—During the 29th and 30th the pressure rose considerably above the normal on the Central Pacific coast, but fell below the normal on the 31st. The highest pressure reported was at Roseburg on the 30th, 0.24 above the normal. Occasional light rain or snow fell during these days on the northern half of the Pacific coast region.

Areas of Low Pressure.—During the month of March sixteen of these areas have passed over the country comprised within the limits of the Signal Service Weather Maps. Of these six have first appeared on the Pacific coast north of California, six have come from Manitoba or Saskatchewan, one developed in the Upper Mississippi and two in the valley of the Lower Rio Grande. The areas of most marked interest are No. II and No. XV. During the passage of No. II violent storms occurred in the Lake region during the 4th and 5th. In connection with area No. XV there prevailed in the Lower Missouri and Upper Mississippi valleys during the 26th and 27th a succession of violent dust and wind-storms which have rarely been equalled in those districts for duration and violence.

No. I.—This area apparently entered British America north of Washington Territory on the morning of the 1st, during which day rain fell in the north Pacific coast region and in western Montana. Central in Montana on the morning of the 1st, it moved southeast and by midnight had reached the Missouri valley, Breckenridge barometer 0.53 and Yankton barometer 0.51 below the normal. On the morning of 2nd Cautionary Signals were ordered for Indianola and Port Eads. During the afternoon signals were displayed for Lake Michigan. The centre on the morning of the 3rd was in southwestern Minnesota and in the afternoon over Lake Superior. On the morning of the 3rd, Cautionary Signals on the north Carolina coast displayed for high area No. I were continued, and Cautionary Signals were displayed northward along the Atlantic coast to New York, and in the afternoon from New Haven northward to Thatcher's Island, at Smithville, Wilmington and Galveston. At midnight the Cautionary Signals on Lake Michigan were lowered, having been fully justified by velocities of SE. 26 at Grand Haven and S. 27 at Milwaukee. Cautionary Signals were then ordered for the Maine coast. During the day brisk to high southerly winds, with rain, prevailed in the Lake region and on the Atlantic slope. The storm moving eastward, on the

morning of the 4th was central in the lower St. Lawrence valley, and during the day passed eastward through New Brunswick over the Atlantic Ocean. The morning of the 4th all signals on the Atlantic coast were lowered, having been fully justified, except at Eastport, with maximum velocities of 40 SE. at Cape Hatteras, W. 48 at Delaware Breakwater, SW. 36 at Sandy Hook, SE. 40 at Wood's Holl and SW. 29 at Thatcher's Island. The signals in the Gulf of Mexico were lowered at midnight, having been justified, except at Galveston. During the passage of this area the maximum temperatures of the month in the State of Maine occurred.

No. II.—The track of this area was very similar to that of No. I. Appearing in British Columbia at midnight of the 1st, it moved southeastwardly through Montana and Dakota to the Lower Missouri valley where it was central on the morning of the 4th, Omaha and Leavenworth barometers 0.55 below the normal. It thence moved northeastwardly and was central that afternoon in eastern Iowa. Cloudy and threatening weather, with fresh to brisk winds, prevailed in the Lake region. Cautionary Signals were then ordered for Lake Michigan and at midnight were displayed at Sandy Hook and Delaware Breakwater. The storm, central in Michigan at midnight of the 4th, reached Lake Ontario on the morning of the 5th. Its passage was marked by violent winds in Ohio, Michigan and Indiana, which are elsewhere treated under the heading of local storms. Maximum velocities were reported of 72 miles W. at Toledo, 36 NE. at Alpena, 33 SW. at Cleveland and 40 W. at Columbus. Cautionary Signals were ordered at that time from Cape Hatteras northward to Eastport. At noon they were changed to Cautionary Off-shore from Cape Hatteras to New York and from Wood's Holl to Portland. Cautionary Off-shore Signals were ordered at Savannah and Charleston, and Cautionary from Smithville to Cape Lookout. The Cautionary Signals for Lake Michigan were then lowered having been fully justified by wind velocities of W. 34 at Milwaukee and W. 42 at Grand Haven. Moving eastward the area was central the 5th off the Maine coast, and at midnight south-east of Nova Scotia. All signals on the Atlantic coast were lowered at midnight of the 5th, except from Delaware Breakwater southward to Fort Macon, which were lowered the morning of the 6th. Except at Charleston and Savannah these signals were fully justified; the following wind velocities being reported: 32 S. at Smithville, 35 SW. at Cape Lookout, 42 SW. at Delaware Breakwater, 36 W. at New Haven, 44 SW. at Thatcher's Island and 35 N. at Eastport. During the passage of this area the maximum temperatures of the month occurred in the Atlantic States (except Maine), in the Lower Lake region, the Ohio valley, Texas and at most stations in the Gulf States.

No. III.—The course of this area was nearly parallel with the tracks of Nos. I and II, except that it was farther northward. Its course from midnight of the 4th to midnight of the 5th was probably southeastward from the coast of British Columbia to Manitoba. During that time cloudy weather, southerly winds, with rain or snow, generally prevailed from Oregon eastward to Dakota. Moving southeastward from Manitoba it was central, with increased pressure, in Minnesota on the morning of the 6th, and in connection with high area No. III, Cautionary Signals were displayed on Lake Michigan. Changing its course to the northeast its centre was over Lake Superior at midnight of the 6th. Cautionary Signals were then ordered for North Carolina and the New Jersey coasts. The afternoon of the 7th the area was in Ontario. Cautionary Signals were then ordered from New York eastward to Wood's Holl, and at midnight the Cautionary Signals were changed to Cautionary Off-shore Signals, and on the following morning, as the storm passed northeastward over the Gulf of St. Lawrence, Cautionary Off-shore Signals were displayed from Newport northward to Portland, and a Cautionary Signal was ordered for Eastport. The signals for Lake Michigan were lowered at midnight of the 7th, having been justified. The signals along the Atlantic coast had already been fully justified, but were all continued as Cautionary Signals until midnight of the 9th, in connection with high area No. IV and low area No. IV.

No. IV.—The pressure in the valley of the Rio Grande decreased during the 5th, and on the morning of the 6th the barometer at Mason was 0.16 below the normal. The area moving northeastward was central at midnight in Indian Territory. A Cautionary Signal was then displayed at Indianola. Moving northeastwardly the area was central afternoon of the 7th in the Ohio valley, and by midnight of that date had passed eastward through Virginia over the Atlantic Ocean. The Cautionary Signals continued along the Atlantic coast from Smithville northward to Wood's Holl during the 7th were fully justified, but were continued from New York to Delaware Breakwater as Cautionary Off-shore, and elsewhere as Cautionary, in connection with low area No. V and high area No. IV. They were fully justified by velocities ranging from 28 to 34 miles E. on the New Jersey coast, and from 26 to 32 miles NE. on the North Carolina coast. The signals on the Texas coast were continued till the 8th in connection with high area No. IV, and are considered in connection therewith.

No. V.—appeared in the valley of the Rio Grande at midnight of the 8th and moved thence northeastwardly over the Gulf of Mexico. On the morning of the 9th it was central in Alabama, and during the day moved eastward through Georgia over the Atlantic Ocean. Cautionary Signals were displayed midnight of the 8th at Cedar Keys, Savannah and Charleston, and the signals on the Carolina coast displayed in connection with high area No. IV were continued. The signals as far north as Wilmington were lowered at midnight of the 9th and northward to Cape Henry on the morning of the 10th. They were all justified, excepting at Charleston and Savannah, by the following wind velocities: Cedar Keys, SW. 28; Fort Macon, NE. 32, and Cape Henry, NE. 40 miles.

No. VI.—This area moved southward along the eastern slope of the Rocky Mountains during the 7th, from Saskatchewan to Montana, where it was central at midnight, Ft. Keogh barometer 0.36 below the nor.

mal. From this point a branch moved southwestwardly through Utah into California and is subsequently described as low area No. VII. The main branch moving southeastward at midnight of the 8th was central in the Lower Missouri valley, Omaha barometer 0.13 below the normal. Cautionary Signals were then ordered for Lake Michigan. On the morning of the 9th this area was central in northwestern Michigan with high area No. IV in the St. Lawrence valley to the eastward and advancing high area No. V to the eastward in the Upper Missouri valley. During the day the area moved eastward while cloudy weather, with snow, prevailed in the Lake region. Signals on Lake Michigan were lowered at midnight, having been fully justified by wind velocities of NW. 38 at Milwaukee and W. 32 at Grand Haven. Central, morning of the 10th in the Lower St. Lawrence valley, during the day it moved northeastward over the Gulf of St. Lawrence.

No. VII.—This area was central as a part of No. VI, in Montana midnight of the 7th, its course thence is an unusual one. Moving southwestward it was central in Utah the morning of the 8th and in southern California at midnight; Visalia barometer 0.28 below the normal. At that time in connection with high area No. II high northerly winds prevailed in central California doing considerable damage as has been noted in a description of that area. Changing its course to the southeastward it passed through Arizona on the 9th, New Mexico on the 10th and reached the valley of the lower Rio Grande the afternoon of the 11th; Brownsville, barometer 0.38 below the normal. Cautionary Signals were displayed at Galveston, Port Eads and Cedar Keys during the 10th and the signal ordered at Indianola the previous night was continued. Moving northeastward the area was central in Arkansas at midnight, and on the morning of the 12th in northern Alabama. On the morning of the 12th in connection with high area No. VII, the Cautionary Signals at Port Eads, Galveston and Indianola, were changed to Cautionary Off-shore Signals. The area moving from Alabama southward over the eastern part of the Gulf of Mexico gradually filled up during the 13th. On the morning of that day all signals in the Gulf were lowered, having been justified, except at Galveston; maximum wind velocities: Cedar Keys, N. 35, Indianola, N. 36.

No. VIII.—Advancing southeastward from Manitoba this area was central the morning of the 10th in the Upper Missouri valley, Bismarck barometer 0.23 below the normal. In the afternoon a Cautionary Signal was displayed at Milwaukee, and on the morning of the 11th at Grand Haven and Ludington. At the latter date the area, with increasing pressure, was over Lake Michigan; thence moving northeastward, with but little energy, it passed over the Gulf of St. Lawrence during the 12th. The signals on Lake Michigan, continued in connection with high area No. VII, were lowered the morning of the 14th, having been justified by a wind velocity of 29 W. at Grand Haven. No other signals were displayed, nor were any other high winds reported in connection with this area.

No. IX.—During the 13th the pressure fell sharply in the Upper Mississippi valley, and at midnight a well-defined area of low pressure, accompanied by brisk, variable winds and snow, covered the Upper Lake region. Moving northeastward the area was central the afternoon of the 14th in the St. Lawrence valley, and during the night it withdrew northeastward through Nova Scotia over the Atlantic Ocean. No signals were displayed during the passage of this area and no high winds have been reported.

No. X.—At midnight of the 14th a sharp barometric fall occurred in the Western Gulf States, and on the morning of the 15th an area of low pressure was central in Louisiana; New Orleans and Mobile barometers 0.14 below the normal. It was central that afternoon in Alabama. Cautionary Signals were then displayed at Port Eads, Cedar Keys and from Cape Henry southward to Fort Macon. Moving northeastward the area, with decreasing pressure, was central at midnight in Tennessee; Montgomery barometer 0.23 below the normal. Cautionary Signals were then ordered at Milwaukee, Toledo, Sandusky and for the New Jersey coast, and on the following morning like signals were displayed for the rest of Lake Erie, the southern half of New England and Wood's Holl. Central the morning of the 16th in Kentucky, it passed off the New Jersey coast over the Atlantic that day. During the day the signals on Lakes Michigan and Erie were lowered, and those along the New Jersey coast were changed to Off-shore, in connection with high area No. VII. The signals along the Atlantic coast were all justified, by north to east winds, with velocities ranging from 26 miles at Thatcher's Island to 30 miles at Sandy Hook. The signals on Lakes Erie and Michigan were but partly justified. Brisk northeast wind, with heavy snow, prevailed on these lakes, and wind velocities of NE. 27 at Grand Haven and NW. 37 at Sandusky were reported.

No. XI.—This area appeared on the Oregon coast on the morning of the 16th. During the 16th and 17th it moved southeastward through Colorado and Utah to Kansas, where it was central at midnight of the latter date; Dodge City barometer 0.22 below the normal. On the morning of the 18th it reached the Lower Missouri valley and moving eastward was central at midnight in Ohio; Louisville and Indianapolis, barometers 0.21 below the normal. At this time a barometric trough extended from the Lake region southward to the Gulf, and a subsidiary area—in connection with which Cautionary Signals had that morning been displayed at Indianola and Galveston—was central in Alabama. Cautionary Signals were then ordered from Kittyhawk southward to Fort Macon, and the signals on the Texas coast—not justified—were lowered. On the morning of the 19th the area was central in Virginia and during the day passed northeastward over the Atlantic Ocean. Cautionary Signals were ordered that morning from Norfolk northward to Wood's Holl. The signals along the New Jersey coast were changed that afternoon to Off-shore. All signals on the Atlantic coast were lowered at midnight, except at Newport and Wood's Holl where they remained displayed until the morning of the 20th. These signals were generally justified by velocities varying from S. 26 at Thatcher's Island to 28 NW. at Cape Lookout, 36 NW. at Chincoteague and 44 NW. at Cape Henry.

No. XII.—This area first appeared on the morning of the 20th northward of Lake Huron. At that time brisk west to south winds prevailed in the Lake region, with maximum velocities of 26 and 28 miles on Lake Michigan. It was central in the afternoon in Ontario; Toronto barometer 0.24 below the normal. By an easterly course it reached Vermont at midnight. During the day brisk to high westerly winds, with snow prevailed on Lake Huron and in the Lower Lake region. The following maximum wind velocities were reported: 32 to 42 W. on Lake Huron, 25 NW. to 37 W. on Lake Erie, from 32 to 40 NW. on Lake Ontario. No signals were displayed in connection with this area in the Lake region. At midnight of the 20th Cautionary Off-shore Signals were displayed from Chincoteague northward along the Atlantic coast to Eastport. By the morning of the 21st this area had passed southeast through Maine over the Atlantic Ocean. The signals from Eastport southward to Chincoteague were lowered that afternoon. These signals, except at Eastport, were fully justified, the following wind velocities having been reported: Thatcher's Island, NW. 30; Wood's Holl, NW. 44; Sandy Hook, NW. 40; Chincoteague, NW. 32.

No. XIII.—passed too far to the northward of the limits of the Signal Service stations to permit its course to be accurately charted. It was apparently central in the northern part of Manitoba the morning of the 20th. Passing through the region to the north of the Upper Lakes during the 21st it moved easterly over the Gulf of St. Lawrence during the 22nd. During the 21st maximum velocities ranging from 26 to 29 miles were reported from several stations on Lakes Superior, Michigan and Huron. In the afternoon Cautionary Signals were ordered for Lake Erie which, not justified in connection with this area, were continued until midnight of the 23rd in connection with advancing low area No. XIV.

No. XIV.—This area was central in Manitoba on the morning of the 2nd. During the afternoon Cautionary Signals were ordered for Lakes Superior and Michigan and the signals ordered on Lake Erie in connection with the previous area were continued. Moving eastward it was central at midnight over Lake Superior and on the morning of the 23rd was to the northward of Lake Huron. At that time Cautionary Signals were ordered for the New Jersey coast and Lakes Ontario and Huron, except at Alpena, where signals had been displayed the midnight previous. In the afternoon the storm was central in Ontario, and at midnight in northern New York. That afternoon Cautionary Signals were displayed from Cape Hatteras to Cape Henry and from New York northward along the Atlantic coast to Eastport. The signals along the New Jersey coast having been fully justified as Cautionary Signals in connection with this area were changed to Cautionary Off-shore Signals for advancing high area No. X, and a similar change of signals was made from New York northward to Portland at midnight, and at Eastport the following morning. The signals for the entire Upper Lake region and at Sandusky and Toledo on Lake Erie were lowered at midnight, having been fully justified by the following wind velocities: Duluth, 32 SW.; Marquette, 33 NW.; Escanaba, Milwaukee and Grand Haven, 36 NW.; Alpena and Detroit, 35 NW., and Sandusky, 50 NW. On the morning of the 24th the area was central, with diminishing pressure in Maine; Portland barometer 0.52 below the normal. Warnings were then sent for Pictou, Halifax, St. John's and Yarmouth, and, in connection with advancing high area No. X, Cautionary Signals were displayed at Norfolk, and from Cape Lookout southward along the Atlantic coast to Smithville. The area moving slowly eastward during the 24th through Nova Scotia passed over the Atlantic ocean during the 25th. The signals at Cleveland, Erie and at stations on Lake Ontario were lowered the afternoon of the 24th, having been fully justified. All the signals along the Atlantic coast were lowered during the 25th, having been justified by violent northerly gales. The following are the highest wind velocities reported: Eastport, 52 NE.; Thatcher's Island, 62 NW.; Wood's Holl, 54 NW.; Sandy Hook and Cape Henry, 56 NW.; Kittyhawk, 44 N.

No. XV.—This area appeared in British Columbia the afternoon of the 24th; Portland barometer 0.46 and Fort Benton barometer 0.45 below the normal. Moving southeastward it was in Idaho the morning of the 25th, and by an easterly path was central in Nebraska the afternoon of the 26th; Omaha barometer 0.75 below the normal. At that time the pressure in the entire Missouri and Upper Mississippi valleys, ranged from 0.40 to 0.75 below the normal. Cautionary Signals were displayed on that morning for Lakes Erie and Huron, and the signals displayed on the preceding day, in connection with high area No. X, for Lakes Michigan and Superior, were continued. In the afternoon Cautionary Signals were displayed at Kittyhawk and Cape Henry and for the New Jersey and Texas coasts. At midnight the area was central in Iowa, at which time the pressure over the greater part of the Lower Missouri and Upper Mississippi valleys was 0.60 below the normal. At that time brisk easterly winds prevailed in the entire Lake region and Mississippi valley generally accompanied by rain, and brisk northerly winds from the Missouri valley westward. On the morning of the 27th the area was central in eastern Iowa—Davenport barometer 1.04 below the normal—in the afternoon in northern Illinois, and at midnight in northwestern Ohio. During the day violent wind-storms, which are elsewhere treated in detail, occurred in the Upper Mississippi and Lower Missouri valleys and in the Upper Lake region. Westward from the Mississippi valley to the Rocky Mountain Slope, but little or no rain falling, remarkable dust-storms prevailed. During the day the following barometer readings occurred, being the lowest on record since the Signal Service stations were opened: St. Louis, 29.16; Davenport, 28.87; Keokuk, 28.95; Milwaukee, 28.94; Dubuque, 28.98. On the morning of that day Cautionary Off-shore Signals were ordered for the Texas coast, at Port Eads and New Orleans, and Cautionary Signals were ordered for the remaining Gulf stations, for Lake Ontario and at all stations along the Atlantic coast, where Cautionary signals were not then displayed, except in Maine where they were hoisted later in the day. On the morning

of the 28th a trough of low pressure extended from Lake Erie southeastward to the New Jersey coast. At that time the pressure over the Lower Lake region, New England, the Middle Atlantic States and North Carolina ranged from 0.50 to 0.70 below the normal. By afternoon the area had passed southeastward off the Virginia coast. The signals in the Lake region were all lowered during the day, having been fully justified, maximum wind velocities having been reported at Duluth, 44 NE.; Milwaukee, 40 E.; Alpena, 35 E.; Toledo, 48 SW.; Oswego, 28 NE. The signals from Wood's Holl southward along the Atlantic coast to Cape Henry, from Charleston to Jacksonville and at all Gulf stations were lowered in the morning, and from Boston northward to Eastport at midnight of the 28th, these signals were fully justified; the following maximum wind velocities having been reported Indianola, 40 S.; Cedar Keys, 42 SW.; Jacksonville and Charleston, 29, SW.; Cape Hatteras, 56 SW.; Chincoteague, 49 SE.; New York and Eastport, 30 NE.; Boston, 40 E. Brisk easterly winds continued on the New Jersey coast during the day, and the Cautionary Signals lowered the morning of the 28th were followed at midnight by Cautionary Off-shore Signals, from Sandy Hook southward to Cape Henry, and at the same time on the North Carolina coast; the Cautionary Signals were lowered at Smithville and Wilmington, and changed to Cautionary Off-shore Signals from Macon to Kittyhawk. These signals were continued until the 31st in connection with high area No. XII. After leaving the North Carolina coast on the 28th this storm evidently moved northeastward inducing, in connection with high area No. XII., the brisk to high northerly winds, which continued to prevail along the Maine and Massachusetts coasts from the 28th until midnight of the 31st.

No. XVI.—This area appeared on the coast of British Columbia, midnight of the 26th, and moving slowly southeastward reached Utah the morning of the 29th and Kansas the 30th, Dodge City barometer at midnight 0.36 below the normal; changing its course to the northeast, it was central the morning of the 31st in the Lower Missouri valley, Omaha barometer 0.35 below the normal. Cautionary Signals were then ordered for Grand Haven, Milwaukee and sections 1 and 3. Continuing its northeasterly course, by midnight of the 31st it passed into the region north of Lake Superior. The Cautionary Signals on Lake Michigan were lowered April 1st; justified by velocities of 26 E. and 40 W.

INTERNATIONAL METEOROLOGY.

Three International charts, Nos. IV, V and VI, accompany the present *Review*. They exhibit the meteorological conditions of the northern hemisphere and portions of the southern hemisphere for the months of *August*, 1878, and *February*, 1880. No. IV indicates the probable course of five of the principal storm-areas occurring over the North Atlantic Ocean during the month of *February*, 1880. Two of these, Nos. I and II, appear to have passed in a northeasterly course after arriving at the 40th meridian, and to have produced southerly gales along the British coasts in two or three days after leaving Newfoundland. The latter of these was encountered by the *Hibernian* on the 10th and 11th; this vessel reports on the 10th in 53° N. 28° W. heavy SE. gale, with heavy rain; 11th, 53° N. 30° W., barometer 28.15, terrific hurricane from SE. to NW. No. III appears to have slowly developed during the 8th in the southwest quadrant of area No. I; on the 9th and 10th it was encountered by the ship *Iron Cross* in about 40° N. 16° W. This vessel reports "on the 9th, at 4 p. m., in 42° N. 16° W., barometer 29.45, wind veering from SSW. to NW; at 11 p. m. a heavy NW. gale commenced, which reached its maximum force about 2 a. m. of the 10th, squalls of nearly hurricane force of 15 minutes duration occurring about every 30 minutes; the barometer rose from 29.48 at 8 p. m. of the 9th to 30.51 at 8 a. m. of the 11th, when the vessel was in 37° N. 17° W." No. IV appeared over mid-ocean on the 12th, and from the 13th to the 18th remained, as an extensive area of remarkably low pressure, over the eastern half of the Atlantic. Steamers *Sardinian* and *Leipzig* report the following, barometer error of former vessel being about -0.35, of latter quite, small.

1880.	Steamship <i>Sardinian</i> .				Steamship <i>Leipzig</i> .			
	Lat.	Long.	Barometer.	Wind.	Lat.	Long.	Barometer.	Wind.
February 15..	54° N.	20° W.	28.20	SSE. 0.	50° N.	12° W.	28.92	SW. 6.
" 16..	58° N.	25° W.	28.00	ENE. 6.	49° N.	16° W.	28.86	NW. 5.
" 17..	51° N.	32° W.	28.68	NNE. 6.	49° N.	19° W.	28.74	WNW. 7.
" 18..	49° N.	40° W.	28.75	N. 7.	49° N.	23° W.	28.77	W. 6.

The following remarks accompany the observations forwarded by the *Sardinian*:—"On February 15th, 16th and 17th, the barometer read from 28.00 to 28.50, the wind, at times, gaining a force of 7 or 8 (Beaufort) to light and variable, and backing twice round from ESE. through NE. and N. to NW. and W.; on the 19th the barometer rose with a steady wind from N., force 7, 8, 6 and 4, thus restoring the equilibrium without any great force of wind. The sea, during this time, was very confused." No. V. developed during the 15th on the coast of North Carolina, and on the 16th and 17th moved rapidly eastward south of Nova Scotia. On the 15th it was encountered by Brig *George*, in 38° 26' N. 72° 48' W., which vessel reports as follows:—"On the morning of the 15th, from 12 midnight to 2 a. m., wind from NE. to E., moderate, but having the appearance of rain. From that time up to time of observation, (7:35 a. m., Washington mean time) baffling winds from ENE. to ESE. and even to SE., with heavy squalls of rain; at 10 a. m. wind